Characterization of Zooplankton Community and Size Composition in Relation to Hydrography and Circulation in the Sea of Japan

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LONG-TERM GOAL

Our ultimate scientific goal is to understand both the biological (e.g., population structure and dynamics and behavior) and physical (e.g., advection, mesoscale physical processes, turbulence) mechanisms that act in concert to produce the observed distributions of plankton in the ocean. Our approach has been to conduct a combination of field, lab, and modeling studies. Field studies define the temporal changes in the distributional patterns of population structure resulting from population growth, swimming behavior, and physical transport. Laboratory studies yield insights into vital rates and behavioral patterns. Modeling ties together the vital rate and behavioral information with the population structure and transport data to determine the mechanisms responsible for observed population distributions.

OBJECTIVES

1) To characterize the zooplankton community of the Japan Sea in terms of taxonomic composition and size structure.

2) To characterize the scales of variability in the zooplankton of the Japan Sea over distances from centimeters to hundreds of kilometers.

3) To determine the relationship between zooplankton taxa and their associated environmental variables over scales from centimeters to hundreds of kilometers. This information will provide insights into the origins of the different zooplankton taxa.

4) To consider the potential flux or exchange of zooplankton into and out of the Sea of Japan through the straits, so that the contribution of physical exchange to resident populations can be quantified.

APPROACH

We plan to conduct a cruise to the Japan Sea during the stratified summer season (June/July 1999) in order to obtain high resolution measurements of the basin-scale distributions of zooplankton abundance and taxonomic and size composition in relation to the hydrography, currents, light, fluorescence, and beam attenuation. Towyo transects will be made using the Video Plankton Recorder to determine distributions of zooplankton and associated variables over scales from centimeters to hundreds of kilometers. We will conduct these VPR surveys during a cruise on the R/V *Revelle* in

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collaboration with Dr. Lynne Talley (SIO), who will conduct basin wide CTD measurements as part of the ONR Japan/East Sea DRI. The proposed work will provide a better understanding of how boreal and tropical zooplankton communities maintain themselves in a dynamic physical environment.

WORK COMPLETED

Work during the present (1st) year of this project involved making preparations for the Japan Sea field study. We improved our automated plankton identification system in terms of speed, accuracy, and ease of use. We also improved the data visualization system. The improved system was tested in the laboratory and during short cruises to local waters. Time also was spend developing cruise logistics and collaborations for the Japan Sea study.

RESULTS

Our research during the current funding period focused on improving the real-time automatic plankton identification system that we developed during the previous funding period. The prototype system had been successfully tested at sea in June 1997 and provided real time identification of plankton and visualization of their distributional patterns on Georges Bank (Davis et al., submitted). After accomplishing our goal of real-time identification/data visualization of plankton, we needed to make improvements to the prototype system in preparation for use in the Japan Sea and more generally for routine use at sea. Although the system was used in real time, in areas of dense plankton patches, the image processing lags behind real time acquisition. The limiting factor was in the extraction of the texture features (granulometric curves) which took about 1-2 seconds per image. We have since improved the speed of this algorithm by a factor of 5, and this together with increases in CPU speed will allow us to conduct real time identifications even in dense patches of plankton. We also are improving the user interface and streamlining the methods for automatic identification for ease of use. The remainder of the year will be spend finalizing plans for the Japan Sea cruise including attending meetings, shipping equipment, and purchasing necessary supplies.

IMPACT/APPLICATION

The proposed study will shed light on the biological/physical interactions controlling zooplankton abundance and community structure in a semi-enclosed marginal sea. Using the data obtained, we can compare a largely closed temperate zooplankton community with one having similar taxonomic composition but which is influenced more strongly by advective input (Gulf of Maine). We also will gain new insights into the impact of advective input of a tropical community into a boreal region. The mixture of the two communities and the potential establishment of a transitional community along the Subpolar Front will allow us to examine how the affinities of zooplankton communities change in response to advective transport over a broad range of scale and the roles of eddies and meanders in promoting exchange between different planktonic and hydrographic regimes. Such information will allow us to better understand how zooplankton communities maintain themselves in a dynamic physical environment.

TRANSITIONS

Our findings will allow better predictions of how zooplankton and large phytoplankton abundance patterns change as a function of hydrography and currents in the Japan Sea. More generally, the

findings will provide a better understanding of how plankton and physical properties are distributed in relation to each other over a broad range of scales in the vicinity of a sharp biogeographic frontal region. This information then can be used to better understand variability in sound and light scattering properties of the ocean.

RELATED PROJECTS

1 – This work will be integrated with the Japan Sea DRI which involves many investigators in physical and optical oceanography.

2 – The Japan Sea findings will be compared with those from our GLOBEC Georges Bank VPR studies which are focusing on cross-frontal exchange of plankton.

PUBLICATIONS

Benfield, M. C., P. H. Wiebe, T. K. Stanton, C. S. Davis, S. M. Gallager, and C. H. Green. Estimating the spatial distribution of zooplankton biomass by combining Video Plankton Recorder and single-frequency acoustic data. *Deep Sea Res*. (in press)

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